OBJECTIONS TO THE DRAWINGS AND SPECIFICATION

The disclosure was objected to due to the absence of a blank space between the word "circuit" and a reference numeral "104" on page 14, line 31. The entire paragraph has been replaced by the present filing to correct this inadvertent error. The drawings were also objected to because the Examiner could not find a reference numeral 136 in the description. Applicants point out that the reference numeral 136 is utilized in the description on page 17, line 21 referring to the horizontal axis shown in Figure 8. Accordingly, the description and drawings are now believed to be in complete conformance with the regulations.

Rejections Under 35 U.S.C. § 102 and under 35 U.S.C. § 103

In the Office Action, claims 1-15, 18-19, 23-25 and 28 were rejected under 35 U.S.C. §102(e) as being anticipated by Souza et al (6,144,205) or in alternative claims 1-15, 18-19, 23-25 and 28 were rejected under 35 U.S.C. §102(e) as being unpatentable over Souza et al (6,144,205). Also, in the Office Action, claims 16-17, 20-22 and 26-27 were rejected under 35 U.S.C. §103(a) as being unpatentable over Souza et al. (6,144,205), in view of Vavrek et al. (5,311,135) and in further view of Applicant's alleged admission of what the Examiner asserted is conventionally well-known and well-established as general knowledge concerning the nature of thyristors (i.e., silicon-controlled rectifiers or SCRs).

A *prima facie* case of anticipation under 35 U.S.C. § 102 requires a showing that each limitation of a claim is found in a single reference, practice or device. *In re Donohue*, 226 U.S.P.Q. 619, 621 (Fed. Cir. 1985). The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (PTO Bd. App. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q.

929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes *all* of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988). One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

The Examiner's formulation of the rejections under §§ 102 and 103 are somewhat confusing and mixed. In particular, it appears to be impossible to tell whether the specific claims are being rejected as anticipated or as made obvious by the Souza et al. reference. In any event, independent claims 1, 10, 18 and 23 have been amended by the present filing to more particularly point out and distinctly claim certain aspects of the invention. In particular, claim 1 has been amended by incorporation of the subject matter of claim 4 therein, and claim 23 has been amended by incorporation of the subject matter of claim 24 in a similar manner. Claims 10 and 18 have been amended by incorporation of similar recitations into their original language. All pending claims are believed to be clearly patentable for the reasons summarized below.

In rejecting claim 1, and in a similar manner in rejecting the other independent claims, the Examiner is said to identified a "switching circuit" as recited in that claim in the Souza et al. reference. The Examiner did not indicate specifically what element should be considered as corresponding to the switching circuit, but referred generally to

Figures 5 and 6 of the reference. The only elements which could serve as a switching circuit in those figures is the semiconductor switch 188 and the photosensitive device 190 in Figure 5, and similarly, the semiconductor switch 116 and the photosensitive semiconductor switch 114 of Figure 6. It should be first noted that nothing in the description or in the diagrammatical circuitry views would indicate that these components serve or are even capable of regulating current conducted between a source and a load as recited in the claims. Indeed, this is not the purpose of the components according to the specification of the Souza et al. reference. Rather, the switches are merely intended to null the response of the resonance circuit at the Larmor frequency to prevent one antenna in the system from affecting performance of other antennae.

Moreover, the Examiner contend that the Souza et al. reference discloses "a current steering circuit" as recited in claim 1 and, in slightly different terms, in the other independent claims. For such circuitry, the Examiner points to blocking loops 178, 194 and 201 of the Souza et al. reference. However, the Examiner's argumentation is entirely inconsistent with the reference and, indeed, identifies the same elements for both the claimed switching device and the current steering circuit. That is, the blocking loops identified by the Examiner as current steering circuits are the identical loops already identified by the Examiner as the switching circuits, that only include the switches discussed above. In the pending claims, and as particularly described in the specification of the instant application, the circuits are different and independent, connected in parallel to permit current to be supplied to a gradient coil assembly even during a period when the switching device ceases to conduct current.

On this specific point, the Examiner's analysis is further at fault. In particular, the Examiner similarly indicates that the identified current steering circuit, apparently blocking loops 187, 194 and 201, conduct current between the source and the load during a second phase of operation, that is, when the signal induced from the transmit fields is electrically isolated. However, it is apparent from the text of the Souza et al. reference

that this is not the function of the blocking loops. Indeed, as indicated, *inter alia*, at column 5, lines 34-37 of the Souza et al. reference, in the receive mode the blocking loop does not complete a parallel resonance circuit. Again, however, it should be stressed that it is not the purpose of the blocking loops to conduct current between the source and the load in the Souza et al. reference. In any event, the Examiner simply cannot substitute the same components of the Souza et al. reference for both the switching circuit recited in the claims and the current steering circuit at the same time.

The independent claims have been amended to more clearly point out that the second phase of operation is that phase of operation during which current is below a non-zero threshold magnitude. It has been found that during that period, current to the gradient coil may be prematurely interrupted due to the nature of the switching device positioned between the amplifier and the gradient coil. None of the circuitry described in the Souza et al. reference is designed to address such concerns, and indeed does not address such concerns. Accordingly, claim 1 and, for similar reasons the other independent claims pending in the present application, are believed to be clearly allowable over the Souza et al. reference. Reconsideration and allowance of the claims are requested.

Claims 16, 17, 20, 21, 22, 26 and 27 were also rejected in the Office Action but under a combination of the Souza et al. reference with a secondary reference, Vavrek et al. As noted above, all of the independent claims are believed to be clearly allowable over the Souza et al. reference. The Vavrek et al. reference does nothing to obviate the deficiencies of Souza et al. as regards the parallel circuits used to continuously supply current between an amplifier and a gradient coil or, more generally, between a source and a load. Accordingly, all of the cited dependent claims are believed to be equally patentable both for the subject matter they separately recite, as well as by virtue of their dependency from an allowable base claim. Reconsideration and allowance of these claims are also requested.

Conclusion

In view of the above remarks and amendments set forth above, Applicants respectfully request allowance of the pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Attached hereto is a marked-up version of the changes made to the drawings and claims by the current amendment. The attached page is captioned **"Version with markings to show changes made."**

Date: 3/7/2002

Respectfully submitted,

PSY

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

The claims have been amended as follows:

1. (Amended) A switching circuit to linearly conduct current between a source and a load, the circuit comprising:

a switching device coupled between the source and the load, the switching device having a conductive state in which a first portion of the current is conducted between the source and the load during a first phase of operation, the first phase of operation dependent on the magnitude of the current; and

a current steering circuit coupled between the source and the load, the current steering circuit having a conductive state in which a second portion of the current is conducted between the source and the load during a second phase of operation in which the magnitude of the current is below a non-zero threshold value.

10. (Amended) A magnetic resonance imaging (MRI) system to perform an MRI scan in accordance with a pulse sequence, the pulse sequence including at least a first pulse, the system comprising:

a gradient coil assembly to generate a gradient magnetic field during the MRI scan;

an amplifier to drive the gradient coil assembly such that the gradient coil assembly generates the gradient magnetic field in accordance with the pulse sequence; and

a switch assembly to provide a conductive path between the amplifier and the gradient coil assembly, the switch assembly comprising:

a first switching device having a conductive state during a first portion of the first pulse of the pulse sequence; and

a second switching device coupled in parallel with the first switching device, the second switching device having a conductive state during a second portion of the first pulse of the pulse sequence during which a current from the amplifier to the gradient coil assembly is below a non-zero threshold value,

wherein the conductive path is provided between the amplifier and the gradient coil assembly during substantially the entire duration of the first pulse.

18. (Amended) A magnetic resonance imaging (MRI) system for acquiring MRI data, the system comprising:

a processor to control acquisition of the MRI data in accordance with a program stored in a memory, the program including an imaging protocol having a sequence of gradient pulses and a sequence of detection pulses;

a gradient amplifier to drive the gradient coil assembly in accordance with the sequence of gradient pulses;

an MRI scanner to perform an MRI scan in accordance with the stored imaging protocol, the MRI scanner comprising a magnet, a gradient coil assembly, and an RF coil assembly, the gradient coil assembly generating a gradient magnetic field in accordance with the sequence of pulses;

a switch assembly coupled between the gradient amplifier and the gradient coil assembly to provide a conductive path therebetween, the switch assembly comprising:

a first switching device having a conductive state during a first portion of a first gradient pulse; and

a second switching device coupled in parallel with the first switching device, the second switching device having a conductive state

during a second portion of the first gradient pulse during which a current from the amplifier to the gradient coil assembly is below a non-zero threshold value,

wherein the conductive path is provided between the gradient amplifier and the gradient coil assembly during substantially the entire duration of the first pulse; and

an RF detector coupled to the RF coil to detect MRI data resulting from the MRI scan in accordance with the sequence of detection pulses.

23. (Amended) A method for performing a magnetic resonance imaging (MRI) scan with an MRI system including a gradient coil assembly, the MRI scan being performed in accordance with a pulse sequence, the method comprising:

receiving a pulse sequence;

generating a current to drive the gradient coil assembly in accordance with the pulse sequence, the current comprising a plurality of current pulses;

conducting the current to the gradient coil assembly through a switch assembly, the switch assembly comprising a first switching device and a second switching device coupled in parallel with the first switching device;

placing the first switching device in a conductive state during a first portion of a first current pulse, the conductive state of the first switching device dependent on the magnitude of the current during the first current pulse; and

placing the second switching device in a conductive state during a second portion of the first current pulse, such that the current is conducted to the gradient coil assembly during substantially the entire duration of the first current pulse wherein placing the second switching device in the conductive state occurs when the absolute value of the magnitude of the current is below a non-zero threshold value.

IN THE SPECIFICATION

The Specification has been amended as follows:

Switching assemblies 90 may include a variety of types of electronic switching devices configured in a number of different topologies. A topology of an exemplary switching assembly 90 is illustrated diagrammatically in Fig. 5. Switching assembly 90 couples a drive 101 (e.g. amplifier 96) to a load 103 (e.g. gradient coil 42). The conductive state of the switching assembly 90 is controlled by a control circuit 105 (e.g. control circuit 40). Switching assembly 90 includes a switching device 102 which, when enabled by control circuit 40, transitions between conductive and non-conductive states to provide a current-carrying path between drive 101 and load 102. In the embodiment illustrated, switching assembly 90 also includes a steering circuit 104 to steer the current between the drive 101 and the load 103 in the event that switching device 102 cannot conduct current in a linear, or uninterrupted, manner. Thus, in applications in which linear conduction of current is a concern, steering circuit_104 ensures that a current-carrying path is provided between drive 101 and load 103 for the entire duration of any current flow, regardless of the magnitude of the current. The incorporation of the steering circuit 104 thus advantageously allows many different types of switching devices 102 to be used, such as transistors, diodes, etc.